IEEE P802.11
Wireless LANs

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| PDT-MAC-UHR-MU-operation |
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 **Abstract**

This document contains Proposed Draft Text (PDT) for the UHR MU operation feature of the proposed 11bn/UHR amendment to the 802.11 standard. This PDT also addresses 4 CIDs 1200, 1619, 1632 and 3275 of TGbn Draft 0.1

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Two more CIDs that can be resolved have been added
* Rev 2: Some minor changes
* Rev 3: Author list updated
* Rev 4: Add line number in the proposed text
* Rev 5: Some minor changes and adding BSRP NTB Trigger frame case in 37.3a.2.3
* Rev 6: Some minor changes related to the new BSRP NTB Trigger frame rule in 37.3a.2.2.4
* Rev 7: Minor changes in 37.3a.2 UHR UL MU operation to incorporate comments from the offline discussion
* Rev 8: Editorial change
* Rev 9: Minor changes to incorporate comments from the more offline discussion
* Rev 10: Some changes related to: (Highlighed in memos)
	+ RU allocation in a UHR MU PPDU (NPCA and DSO exceptions)
	+ BSRP NTB Trigger frame from both a UHR AP and non-AP UHR STA
	+ Aligning with D0.3
* Rev 11: Some changes related to the exception for the NPCA based on Brian’s comment. The tracked changes in this revision are made based on the current draft.
* Rev 12: Some changes based on more offline discussions (Remove descriptions related to the BSRP NTB Trigger frame)
* Rev 13: Some changes related to the Partial bandwidth

**Introduction**

Interpretation of a Motion to Adopt.

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGbn Draft. The abstract, revision information, introduction, explanation of the proposed changes and references sections are not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGbn Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

***TGbn Editor: Editing instructions preceded by “TGbn Editor” are instructions to the TGbn editor to modify existing material in the TGbn draft. As a result of adopting the changes, the TGbn editor will execute the instructions rather than copy them to the TGbn Draft.***

**Relevant passing motions:**

[Motion #196]

**Move to add to the TGbn SFD the following:**

* MU-MIMO+OFDMA in both DL and UL is limited to UHR PPDU of 160 and 320MHz only
	+ 160MHz PPDU – 996 and, when the PPDU is punctured, 484+242
	+ 320 MHz PPDU: 2x996, 3x996 and, when the PPDU is punctured, 996+484, 2x996+484
* MU-MIMO+OFDMA is further limited to a maximum of 2RUs supporting MU-MIMO and each 80MHz segment is either MU-MIMO or OFDMA
* RU Allocation table in UHR-SIG is the same as that in EHT-SIG except that the rows for RU 242, 484 and 3x996+484 with two or more users are changed to Validate

**CIDs**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CID** | **Clause** | **PP.LL** | **Comment** | **Proposed Change** | **Resolution** |
| 1200 | 9.3.1.22.6 | 47.61 | In DL OFDMA+MU-MIMO, the limitation of the size of RUs for this transmission was defined. to align with DL OFDMA+MU-MIMO, this limitation can be applied to UL MU-MIMO in TB PPDU transmission. Define the size of RU for UL-MU-MIMO in TB PPDU, and add the description for this. | Add the description for UL MU-MIMO in TB PPDU and RU restriction. | Revised.This is addressed in subclause 38.3.3.1, which is proposed in PDT 11-25/701r2**TGbn editor, please make the changes tagged by CID #1200 in PDT 11-25/0839.** |
| 1619 | 38.3.3 | 109.31 | Define 37.x.y (RU allocation in a UHR MU PPDU), | as in comment | Revised.Agree with the commenter. The subclause “RU allocation in a UHR MU PPDU” is added**TGbn editor, please make the changes tagged by CID #1619 in PDT 11-25/0839.** |
| 1632 | 38.3.15.5 | 141.35 | Define 37.x.x.x.x (Allowed settings of the Trigger framefields and TRS Control subfield) | as in comment | Revised.Agree with the commenter. The subclause “Allowed settings of the Trigger frame fields and TRS Control subfield” is added**TGbn editor, please make the changes tagged by CID #1632 in PDT 11-25/0839.** |
|  3275 | 9.3.1.22.6 | 47.65 | We should disallow the RU Allocation field indicate a RU located in more than one 80MHz subblocks where the corresponding bits in the DRU/RRU Indication subfield set to unequal values. | See Comment | Rejected.This was already covered by the DRU/RRU Indication subfield of the Common Info field in subclause 9.3.1.22.2. Therefore, we don’t need to further describe any restrictions regarding RU allocation. |

**Discussion:**

The subclause, 37.3 (UHR MU operation) should be almost same as the subclause, 35.5 (MU operation). This should be referenced, and additional rules are described in each subclause of 37.3a (UHR MU operation).

**Text to be adopted begins here.**

***TGbn editor: Please update UHR MAC Capabilities in 11bn D0.3 to add UHR TRS Support field as below***

9.4.2.aa2.2 UHR MAC Capabilities Information field

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 | B2 | B4 | B5 | B6 | B7 |
|  | DPS Support | DPS Assisting Support | Multi-Link Power Management | NPCA Supported | BSR Enhancement Support | AdditionalMappedTIDSupport | EOTSP Support |
| Bits: | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B8 | B9 | B10 | (#1632) B11 | … | … | … | B11 Bz |
|  | DSOSupport | P-EDCASupport | DBESupport | UHR TRS Support | … | … | … |  |
| Bits: | 1 | 1 | 1 | 1 | … | … | … | X |

**Figure 9-aa5 —UHR MAC Capabilities Information field format**

**Table 9-349c—Subfields of the UHR MAC Capabilities Information field**

|  |  |  |
| --- | --- | --- |
| **Subfield** | **Definition** | **Encoding** |
| **…** | **…** | **…** |
| (#1632) UHR TRS Support | For a non-AP STA, indicates support for transmitting a UHR TB PPDU after receiving a frame with a TRS Control subfield. | For a non-AP STA that has set the +HTC-HE Support subfield to 1:Set to 1 if the STA supports transmitting a UHR TB PPDU after receiving a frame with a TRS Control subfield.Set to 0 otherwise.Reserved for an AP or if the +HTC-HE Support subfield is 0. |
| **…** | **…** | **…** |

***TGbn editor: Please update the following subclause 37.3 UHR MU operation to the 802.11bn draft***

37.3 UHR MU operation (#1609, 2906)

37.3.1 UHR DL MU operation

37.3.1.1 General

When transmitting or receiving a UHR MU PPDU, the rules defined in 35.5.1.1 (General) and 35.5.1.2 (RU allocation in an EHT MU PPDU) that apply to an EHT MU PPDU shall also apply to the UHR MU PPDU. In cases where a rule in 35.5.1.1 (General) or 35.5.1.2 (RU allocation in an EHT MU PPDU) refers to RUs and MRUs in an EHT MU PPDU, the rules also apply to RUs and MRUs in a UHR MU PPDU along with the additional rules defined below.

[M196] (#1200) A UHR AP shall not transmit a UHR MU PPDU with an RU or MRU that is narrower than the PPDU bandwidth and that is allocated to more than one STA (DL MU-MIMO within OFDMA) unless the AP has received from each STA a UHR Capabilities element with the Partial Bandwidth DL MU-MIMO subfield in the UHR PHY Capabilities Information field equal to 1.

37.3.1.2 RU allocation in a UHR MU PPDU (#1619)

 A UHR STA shall follow the rules defined below and in 35.5.1.2 (RU allocation in an EHT MU PPDU), where

* Rules related to EHT STAs also apply to UHR STAs.
* Rules related to EHT MU PPDUs also apply to UHR MU PPDUs.
* Rules related to RUs and MRUs in an EHT MU PPDU also applies to RUs and MRUs in a UHR MU PPDU

In a 40 MHz, 80 MHz, 160 MHz or 320 MHz UHR MU PPDU, an AP shall not allocate to a 20 MHz operating non-AP STA an RU or MRU that is not supported by the STA as indicated in 38.3.2.4 (RU and MRU restrictions for 20 MHz operation).

A UHR AP, while it has not switched to the NPCA primary channel, shall not allocate an RU or MRU in the secondary 160 MHz of a 320 MHz UHR MU PPDU or UHR TB PPDU to a 20 MHz operating non-AP UHR STA. A UHR AP, while it has not switched to the NPCA primary channel, shall not allocate an RU or MRU outside of the primary 20 MHz in a 40 MHz, 80 MHz, 160 MHz, or 320 MHz UHR MU or UHR TB PPDU to a 20 MHz operating non-AP UHR STA if the 20 MHz operating non-AP UHR STA has not set up SST operation on a nonprimary 20 MHz channel with the UHR AP.

A UHR AP, while it has not switched to the NPCA primary channel, shall not allocate an RU or MRU in the secondary 160 MHz channel of a 320 MHz UHR MU PPDU or UHR TB PPDU to an 80 MHz operating non-AP UHR STA. A UHR AP, while it has not switched to the NPCA primary channel, shall not allocate an RU or MRU in the secondary 80 MHz channel of a 160 MHz or 320 MHz UHR MU or UHR TB PPDU to an 80 MHz operating non-AP UHR STA, if the 80 MHz operating non-AP UHR STA has not set up SST operation on the secondary 80 MHz channel with the UHR AP or there is an inactive 20 MHz subchannel within the secondary 80 MHz channel.

A UHR AP, while it has not switched to the NPCA primary channel or not a DSO AP initiating a DSO frame exchange that requires the DSO non-AP STA(s) to switch to the DSO subband, shall not allocate an RU or MRU in the secondary 160 MHz channel of a 320 MHz UHR MU PPDU or UHR TB PPDU to a 160 MHz operating non-AP UHR STA.

A UHR AP that is an NPCA AP that has switched to the NPCA primary channel, shall not allocate an RU or MRU to one of the following:

* An associated 20 MHz operating non-AP NPCA STA in any of channel(s) other than the 20 MHz channel including the NPCA primary channel in a 20, 40, 80, 160 or 320 MHz UHR MU or UHR TB PPDU.
* An associated 80 MHz operating non-AP NPCA STA in any of channel(s) other than the 80 MHz channel including the NPCA primary channel in an 80, 160 or 320 MHz UHR MU or UHR TB PPDU.
* An associated 160 MHz operating non-AP NPCA STA in any of channel(s) other than the 160 MHz channel including the NPCA primary channel in a 160 or 320 MHz UHR MU or UHR TB PPDU.

[M196] The UHR AP shall follow the rules defined in 38.3.3.1 (Supported RU or MRU sizes in partial bandwidth DL and UL MU-MIMO) (#1200) for RU allocation of a UHR MU PPDU if the AP has received from each recipient STA a UHR Capabilities element with the Partial Bandwidth DL MU-MIMO subfield in the UHR PHY Capabilities Information field set to 1.

37.3.2 UHR UL MU operation

37.3.2.1 General

UHR UL MU operation allows an AP to solicit simultaneous immediate response frames from one or more non-AP UHR STAs. UHR UL MU operation expands the UL MU functionalities inherited from EHT. The rules defined in 35.5.2.1 (General) that apply to an EHT STA shall also apply to the UHR STA and the additional rules defined below.

A UHR AP shall not set the UL UHR-MCS subfield of a UHR variant User Info field to 15 in a transmitted Trigger frame if the RU assigned by that User Info field is used for UL MU MIMO transmission.

A UHR AP shall not set the UL UHR-MCS subfield of a UHR variant User Info field to 14 in a transmitted Trigger frame.

A non-AP UHR STA shall set the UHR TRS Support subfield in the UHR MAC Capabilities Information field in the UHR Capabilities element to 1 if its dot11UHRTRSOptionImplemented is true; otherwise, the STA shall set the field to 0.

A UHR AP shall not include the Special User Info field in a Trigger frame if the Trigger frame does not include an EHT or UHR variant User Info field.

37.3.2.2 Rules for soliciting UL MU frames

37.3.2.2.1 General

A UHR STA shall follow the rules below and defined in 35.5.2.2.1 (General), where

* Rules related to EHT STAs also apply to UHR STAs.
* Rules related to triggering frames also apply to triggering frames soliciting UHR TB PPDUs.
* Rules related to EHT MU and EHT TB PPDUs also apply to UHR MU PPDUs and UHR TB PPDUs, respectively.

A UHR AP shall not transmit an HE or EHT PPDU that carries a Trigger frame soliciting a UHR TB PPDU.

A UHR AP shall not transmit a UHR PPDU that carries a Trigger frame soliciting an HE or EHT TB PPDU.

[M196] A UHR AP shall not transmit a Trigger frame soliciting an OFDMA transmission using a UHR TB PPDU that uses UL MU-MIMO(#1200) within an RU or MRU to a non-AP UHR STA from which the AP has not received a UHR Capabilities element with the Partial Bandwidth UL MU-MIMO subfield of the UHR Capabilities Information field equal to 1.

In a 40 MHz, 80 MHz, 160 MHz, or 320 MHz UHR TB PPDU, an AP shall not allocate to a 20 MHz operating non-AP STA an RU or MRU that is not supported by the STA as defined in 38.3.2.4 (RU and MRU restrictions for 20 MHz operation).

[M196] The UHR AP shall follow the rules defined in 38.3.3.1 (Supported RU or MRU sizes in partial bandwidth DL and UL MU-MIMO) (#1200) for soliciting an OFDMA transmission using a UHR TB PPDU that uses UL MU-MIMO within an RU or MRU to a non-AP UHR STA from which the AP has received from a UHR Capabilities element with the Partial Bandwidth UL MU-MIMO subfield of the EHT PHY Capabilities Information field set to 1.

37.3.2.2.2 Requirements for allocating resources

A UHR AP shall follow the requirements for allocating resources specified in 35.5.2.2.2 (Requirements for allocating resources) where rules related to EHT STAs also apply to UHR STAs, and rules related to EHT TB PPDUs also apply to UHR TB PPDUs.

37.3.2.2.3 Allowed settings of the Trigger frame fields and TRS Control subfield (#1632)

A UHR AP may transmit a Trigger frame that solicits a UHR TB PPDU from a UHR STA subject to the rules defined in 26.5.2.2 (Rules for soliciting UL MU frames), 35.5.2.2 (Rules for soliciting UL MU frames) and the additional rules defined below.

A UHR AP shall not transmit a Trigger frame that solicits in any of the following:

* an HE TB PPDU and an EHT TB PPDU.
* an HE TB PPDU and a UHR TB PPDU.
* an EHT TB PPDU and a UHR TB PPDU.
* an HE TB PPDU, an EHT TB PPDU and a UHR TB PPDU together.

A UHR AP shall set the UL Length subfield of a transmitted Trigger frame that solicits a UHR TB PPDU to the value given by Equation (27-11) with m = 2, except that TXTIME is defined by Equation (38-61) in 38.4.3 (TXTIME and PSDU\_LENGTH calculation).

NOTE 1—This is the same rule as that of an AP that transmits a Trigger frame that solicits an HE TB PPDU (see 26.5.2.2.4 (Allowed settings of the Trigger frame fields and TRS Control field)) or EHT TB PPDU (see 35.5.2.2.4 (Allowed settings of the Trigger frame fields and TRS Control subfield)).

An AP shall not send a frame with a TRS Control subfield that solicits a UHR TB PPDU to a non-AP STA from which the AP has not received a UHR MAC Capabilities Information field in the UHR Capabilities element with the UHR TRS Support subfield equal to 1.

An AP shall not send a PPDU that is not an HE PPDU, an EHT PPDU or a UHR PPDU, that carries a TRS Control subfield.

37.3.2.3 Non-AP STA behavior for UL MU operation

37.3.2.3.1 General

A UHR STA shall follow the rules below and defined in 35.5.2.3.1 (General), where

* Rules related to EHT STAs also apply to UHR STAs.
* Rules related to EHT variant User Info field also apply to UHR variant User Info field.
* Rules related to EHT MU and EHT TB PPDUs also apply to UHR MU PPDUs and UHR TB PPDUs, respectively.

If a non-AP UHR STA receives a UHR variant User Info field in a Trigger frame in which the AID12 subfield matches the STA’s AID, then if the Trigger frame is not an MU-RTS or BSRP NTB Trigger frame, the STA shall respond with a UHR TB PPDU. If a non-AP UHR STA receives an HE variant User Info field in a Trigger frame in which the AID12 subfield matches the STA’s AID, then if the Trigger frame is not an MU-RTS or BSRP NTB Trigger frame, the STA shall respond with an HE TB PPDU. If a non-AP UHR STA receives an EHT variant User Info field in a Trigger frame in which the AID12 subfield matches the STA’s AID, then if the Trigger frame is not an MU-RTS or BSRP NTB Trigger frame, the STA shall respond with an EHT TB PPDU.

A non-AP UHR STA shall not send a UHR TB PPDU unless the STA is explicitly triggered by an AP in the operation modes described in 37.3.2.3.2 (TXVECTOR parameters for UHR TB PPDU response to Trigger frame).

37.3.2.3.2 TXVECTOR parameters for UHR TB PPDU response to Trigger frame

***TGbn editor: Please leave this as a placeholder subclause. This subclause can be completed after the TXVECTOR parameters for UHR are defined.***

37.3.2.3.3 TXVECTOR parameters for UHR TB PPDU response to TRS Control subfield

***TGbn editor: Please leave this as a placeholder subclause. This subclause can be completed after the TXVECTOR parameters for UHR are defined.***

37.3.2.3.4 Conditions for not responding with a TB PPDU

A UHR STA shall follow the rules defined in 35.5.3.4 (Conditions for not responding with a TB PPDU), where

* Rules related to EHT STAs also apply to UHR STAs.
* Rules related to triggering frames also apply to triggering frames soliciting UHR TB PPDUs.
* Rules related to EHT TB PPDUs also apply to UHR TB PPDUs.

37.3.2.4 UL MU CS mechanism for UHR STAs

A UHR STA shall follow the rules defined in 35.5.2.4 (UL MU CS mechanism for EHT STAs), except that the UHR STA shall use the rules defined in 38.3.26.6.4 (Per 20 MHz CCA sensitivity) instead of those defined in 36.3.21.6.4 (Per 20 MHz CCA sensitivity) when CCA is performed on any nonpunctured 20 MHz subchannel in a UHR BSS, along with the additional rules defined below.

Specifically, if the CS Required subfield in a Trigger frame is 1, then the non-AP STA shall consider the status of the CCA (using energy detect defined in 38.3.26.6.4 (Per 20 MHz CCA sensitivity) and the virtual carrier sense (NAV)) during the SIFS between the PPDU that contains the Trigger frame and the PPDU sent in response to the Trigger frame. In this case, when performing CCA, the non-AP STA shall sense the medium using energy detect after receiving the PPDU that contains the Trigger frame (i.e., during the SIFS), and the STA shall perform the energy detect at least in the subchannel that contains the non-AP STA’s UL allocation, where the sensed subchannel consists of one or more occupied 20 MHz channels. The non-AP STA may transmit the solicited PPDU if all the occupied 20 MHz channels containing the RUs allocated in the Trigger frame are considered idle. If the non-AP STA detects that any of the occupied 20 MHz channels containing the allocated RUs is not idle, then the non-AP STA shall not transmit.